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Enquiry for Letters of Gauss.

A letter has been received from Professor Stäckel, of Kiel University, asking that publicity may be given to the following request :—

The *Königliche Gesellschaft der Wissenschaften zu Göttingen* hopes shortly to complete the edition of the works of Carl Friedrich Gauss. The *Gesellschaft* therefore requests all those persons or Societies who are in possession of any manuscripts or information of interest concerning Gauss, kindly to communicate such material.

The Sidereal System Revised in 1898. By Maxwell Hall, M.A.

Up to the present time the solar orbit has been assumed to be circular, and both Γ and Λ have been taken equal to zero ; but it will be found that the theory is considerably improved by taking $\Lambda = -1$ as a first approximation.

Referring to the formulæ for computation, *Monthly Notices*, vol. lvii. pp. 360, 370, for $v^2 = \mathrm{F}r_0{}^2$, we now have

$$\rho_0 = \frac{2\mathrm{V}(au - b + \mathrm{H}\Pi\mathrm{V})}{c^2 + u^2 - \Pi^2\mathrm{V}^2 + \Lambda \,.\, \varpi^2\mathrm{V}^2 \,.\, \Pi^2 r_0{}^2}.$$

The last term in the denominator becomes of great importance among those stars whose computed parallaxes are large ; and the results of the last general computation clearly show that such a controlling term is required.

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We shall now recompute all parallaxes and radial velocities on the supposition that $v^2 = \mathrm{F}r_0^2$; but, when necessary, on the supposition that $v^2 = \mathrm{F}r_0$, the circumstance being duly noted, as recommended in the last revision referred to above, p. 369.

We now require an expression for ρ_0, when $v^2 = \mathrm{F}r_0$; and as the expression for ρ_0 when $v^2 = \mathrm{F}r_0^2$, as given above, leads to unnecessary complications—such, for instance, as that in some cases the numerator and denominator of ρ_0 are both negative—we shall take a simpler form.

Thus

$$v^2 = \mathrm{F}r_0,$$

and in the case of the Sun,

$$\mathrm{V}^2 = \mathrm{FR}_0 + \Lambda\mathrm{V}^2,$$

or

$$\mathrm{F} = \Pi\mathrm{V}^2(1 - \Lambda).$$

And as we have taken $\Pi = 0{\cdot}02$, $\mathrm{V} = 5$, and $\Lambda = -1$, it follows that $\mathrm{F} = 1$; but we shall retain F in the equations, as it is not likely that 1 will be its final value.

Now, referring to the fundamental equations

$$v^2 = \mathrm{V}^2 + (c^2 + u^2)\rho_0^2 - 2\mathrm{V}(au - b)\rho_0;$$

therefore

$$(c^2 + u^2)\rho_0^2 - 2\mathrm{V}(au - b)\rho_0 = \mathrm{F}r_0 - \mathrm{V}^2,$$

or

$$(c^2 + u^2)\rho_0 - 2\mathrm{V}(au - b) = \varpi(\mathrm{F}r_0 - \mathrm{V}^2),$$

whence

$$\rho_0 = \frac{2\mathrm{V}(au - b) + \varpi(\mathrm{F}r_0 - \mathrm{V}^2)}{c^2 + u^2}.$$

And, collecting our expressions as on p. 370, *Monthly Notices*, vol. lvii., we have

$$\mathrm{F} = \Pi\mathrm{V}^2(1 - \Lambda)$$

$$v^2 = \mathrm{F}r_0;$$

$$r_0 = \sqrt{\mathrm{R}_0^2 + \rho_0^2 + 2\mathrm{HR}_0\rho_0};$$

$$u = \frac{\mathrm{K} + a\Pi\mathrm{V} + \varpi\Gamma\mathrm{V}}{\mathrm{H} + \Pi\rho_0.};$$

$$\Gamma = \mathrm{L}\lambda + \mathrm{M}\mu + \mathrm{N}\nu;$$

$$\rho_0 = \frac{2\mathrm{V}(au - b) + \varpi(\mathrm{F}r_0 - \mathrm{V}^2}{c^2 + u^2};$$

$$\frac{d\rho}{at} = -u\rho_0;$$

$$\varpi = \frac{1}{\rho_0}.$$

From the former list of stars we shall omit No. 2, a Argûs

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(*Canopus*), whose proper motions are zero; but to that list we must add the following:—

Star	Mag.	R.A. 1850	P.M. in R.A.	N.P.D. 1850	P.M. in N.P.D.
		h m s	s	° ′	″
α Eridani	0·5	1 32 7	+0·0080	148 0	+0·070
α Scorpii	1·1	16 20 13	− ·0022	116 6	+ ·028
β Centauri	1·2	13 53 17	− ·0100	149 39	+ ·050
α Crucis	1·3	12 18 18	− ·0060	152 16	+ ·040
α Piscis Aust.	1·3	22 49 21	+ ·0232	120 25	+ ·159
β Crucis	1·4	12 39 0	− ·0090	148 52	+ ·030
α Gruis	1·9	21 58 45	+ ·0110	137 41	+ ·150
β Hydri	2·7	0 17 47	+ ·7200	168 6	− ·320
δ Ursæ Maj.	3·4	12 7 59	+ ·0133	32 8	− ·004
η Aquilæ	4·1	19 44 50	− ·0017	89 23	+ ·003
β Comæ	4·4	13 4 52	− ·0605	61 22	− ·897
31 Aquilæ	5·3	19 17 49	+0·0487	78 22	−0·651

The above P.M.s are those of Dr. Auwers and those of Dr. Stone, as adopted by the *Nautical Almanac*. The following are the results of observation:—

Star.	″	Parallax, &c.			
α Eridani		Gill.			
α Scorpii	0·021	Finlay,	*Monthly Notices*,	vol. lviii.	p. 172.
β Centauri	0·046	Gill.	,,	,,	,,
α Crucis		,,			
α Piscis Aust.	0·130	,,	,,	,,	,,
β Crucis		,,			
α Gruis	0·015	,,	,,	,,	,,
β Hydri		,,			
δ Ursæ Maj.	0·09	Bruno Peter,	*Nature*,	vol. lvii.	p. 546.
η Aquilæ	$\frac{d\rho}{dt} = -1.$	Belopolsky,	,,	,,	p. 353.
β Comæ	0·11	Bruno Peter,	,,	,,	p. 546.
31 Aquilæ	0·06	,,	,,	,,	,,

It will be convenient to arrange the results of the recomputation in two Tables, the first containing satisfactory, or fairly satisfactory, results, from stellar orbits more or less circular; and the second containing failures probably due to elliptic, or highly elliptic, orbits.

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TABLE I.

No.	Star.	Observed. ϖ	Observed. $\frac{d\rho}{dt}$	Computed. ϖ	Computed. $\frac{d\rho}{dt}$
		″		″	
1	α Canis Maj. (*Sirius*)	0·27	0 ?	0·17	0
3	α Boötis (*Arcturus*)	0·07	− 9	0·31	− 9
4	α Centauri	0·72	...	0·65	− 3
5	α Aurigæ (*Capella*)	0·07	+ 7	0·06	+ 6
6	β Orionis (*Rigel*)	0·03	+ 4	0·04	+ 11
7	α Lyræ (*Vega*)	0·12	− 9	0·14	− 11
*	α Eridani (*Achernar*)	...	...	0·01	− 1
8	α Canis Min. (*Procyon*)	0·23	+ 2	0·11	+ 5
9	α Orionis	0·02	+ 6	0·04	+ 10
10	α Aquilæ (*Altair*)	0·20	− 8	0·26	− 10
11	α Tauri (*Aldebaran*)	0·10	+ 11	0·04	+ 9
12*	α Virginis (*Spica*)	...	− 4	0·00	− 2
*	α Scorpii (*Antares*)	0·02	...	0·00	− 4
*	β Centauri	0·05	...	0·00	+ 1
14	α Leonis (*Regulus*)	0·09	+ 1	0·02	+ 6
*	α Crucis	...	...	0·00	+ 3
	α Piscis Aust. (*Fomalhaut*)	0·13	...	0·06	− 6
*	β Crucis	...	...	0·00	+ 2
15	α Cygni	0·01	− 7	0·02	− 8
16	α Gemin. (*Castor*)	...	− 6†	0·49	− 4
18	ε Orionis	...	+ 6	0·04	+ 11
20*	ε Ursæ Maj.	0·08	− 1 ?	0·02	− 4
21	α Persei	0·09	− 6	0·03	− 1
22	β Tauri	0·06	+ 2 †	0·04	+ 8
23	α Ursæ Maj.	0·05	− 9	0·20	− 8
24*	η Ursæ Maj.	...	− 6	0·01	− 5
	α Gruis	0·02	...	0·01	− 2
25*	β Aurigæ	0·06	− 6	0·08	− 4
26	α Andromedæ	0·06	− 4 ?	0·03	− 1
27	α Ursæ Min. (*Polaris*)	0·05	− 6	0·03	− 9
28	γ Andromedæ	...	− 3	0·00	0
29	α Arietis	0·08	− 4	0·03	+ 3
31	γ Cassiopeiæ	0·01	− 4	0·02	− 4
32	β Andromedæ	0·07	+ 2	0·03	+ 1

* $v^2 = Fr_0$. † Potsdam.

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No.	Star.	Observed. ϖ	Observed. $\frac{d\rho}{dt}$	Computed. ϖ	Computed. $\frac{d\rho}{dt}$
		″		″	
34*	γ Leonis	...	− 9	0·13	− 3
35	β Leonis	0·03	− 3	0·03	+ 1
36*	ζ Ursæ Maj.	...	− 7†	0·02	− 4
40	γ Cygni	0·10	− 3	0·02	− 9
41	β Cassiopeiæ	0·16	0	0·06	− 4
42	α Cassiopeiæ	0·04	− 3	0·02	− 4
43	β Persei (*Algol*)	0·05	0	0·01	+ 2
44*	β Ursæ Maj.	0·08	0	0·02	− 1
45	γ Ursæ Maj.	0·10	− 5†	0·04	− 3
47*	ε Pegasi	0·08	+ 2†	0·05	+ 2
48	α Pegasi	0·08	0†	0·03	+ 2
49*	ε Boötis	...	− 4	0·00	3
50	α Cephei	0·06	− 14	0·03	− 9
51	β Pegasi	...	+ 1	0·05	− 2
	β Hydri	...	...	0·22	+ 7
52*	β Libræ	...	− 2	0·01	− 4
53*	α Serpentis	...	+ 5	0·03	+ 1
54	ε Cygni	0·13	...	0·03	− 7
55*	δ Leonis	...	− 3	0·04	− 4
56*	β Herculis	...	− 8	0·01	− 8
60	δ Herculis	0·08	...	0·01	− 11
*	δ Ursæ Maj.	0·09	...	0·03	− 3
62	η Cassiopeiæ	0·31	...	0·11	− 3
64	10 Ursæ Maj.	0·20	...	0·05	+ 5
65	70 (p) Ophiuchi	0·22	...	0·17	− 10
66	θ Cassiopeiæ	0·23	...	0·04	+ 2
67	e Eridani	0·14	...	0·56	+ 12
68	o² Eridani	0·19	...	0·57	+ 1
	β Comæ	0·11	...	0·38	+ 3
69	δ Ursæ Min.	0·03	...	0·03	− 9
70	δ Equulei	0·04	...	0·06	+ 3
71	σ Draconis	0·25	...	0·38	− 3
72	ν² Draconis	0·28	...	0·11	− 13
73	ν¹ Draconis	0·32	...	0·11	− 11
75	61 Cygni	0·43	...	0·67	− 7
76	μ Cassiopeæ	0·18	...	0·32	− 2
77	ε Indi	0·22	...	0·45	+ 6

* $v^2 = Fr_0$. † Potsdam.

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No.	Star.	Observed. ϖ	Observed. $\frac{d\rho}{dt}$	Computed. ϖ	Computed. $\frac{d\rho}{dt}$
		″		″	
78	Cephei 51 (Hev.)	0·03	...	0·04	− 8
79	3077 Bradley	0·18	...	0·21	− 4
80	85 Pegasi	0·06	...	0·12	− 1
81	20 Leonis Min.	0·06	...	0·09	−10
83	1618 Groombridge	0·25	...	0·69	+ 5
84	Σ 1516	0·15	...	0·17	−10
87	Σ 2398	0·35	...	0·96	+ 2
88	34 Groombridge	0·31	...	0·30	− 1

Table II.

No.	Star.	Observed. ϖ	Observed. $\frac{d\rho}{dt}$	Computed. ϖ	Computed. $\frac{d\rho}{dt}$
13	β Gemin. (*Pollux*)	″ 0·06	− 7 ?	″ ...	...
17	γ Orionis	...	+ 2	0·04	+10
19	ζ Orionis	...	+ 3	0·04	+10
30	γ Geminorum	...	− 4	0·10	+10
33	δ Orionis	...	0	0·4	+11
37	β Ursæ Min.	0·02	+ 3	0·04	−10
38	α Ophiuchi	...	0 ?	0·02	− 5
39*	α Coronæ	...	+ 7	0·02	− 4
46	γ Draconis	0·07	− 2	0·04	−12
57	ι Ursæ Maj.	0·13	...	0·84	− 6
58	θ Ursæ Maj.	0·05	...	1·54	− 7
59	α Herculis	0·05	...	...	...
61	π Herculis	0·11	...	1·25	−12
63	η Herculis	0·40	...	...	...
	η Aquilæ	...	− 1	0·04	− 9
74	ζ Toucani	0·06	...	1·72	+ 9
	31 Aquilæ	0·06	...	0·46	−10
82	1830 Groombridge	0·13	...	2·67	− 6
85	21 185 Lalande	0·46	...	1·50	− 7
86	9352 Lacaille	0·28	...	2·30	− 5
89	21 258 Lalande	0·23	...	2·32	+ 4
90	17 415 Oelt. Argel.	0·20	...	1·40	+ 2
91	11 677 Oelt. Argel.	0·18	...	1·25	− 9

By comparing Tables I. and II. we arrive at the following results :—

1. The present revision gives about 20 per cent. of failure,

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* $v^2 = Fr_0$.

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while the last revision gave about 40 per cent.; and in consequence the introduction of Λ has proved a marked success.

2. But the percentage of failure is not constant throughout the list; the stars are arranged according to their magnitudes, and while the percentage is very small among the brighter stars, it increases as the stars diminish in brightness; and among the very faint stars (which were, of course, picked out for observation of parallax on account of their very large proper motions), there are many failures.

No. of Stars Computed.	No. of Failures.	Percentage of Failure.
10	0	0
20	1	5
30	3	10
40	5	12
50	8	16
60	9	15
70	13	19
80	15	19
90	17	19
100	21	21

3. Now when it is remembered that a large number of the brighter stars give correct results in *both* parallax and radial velocity, there can be no doubt that as far as our problem is concerned the brighter stars should be observed for parallax and radial velocity instead of the fainter stars having abnormally large proper motions; and as the numerical work is now becoming very heavy, it seems advisable to omit at present the further computation of stars of the latter class.

4. In the last revision of 1896 the results from $v^2 = \mathrm{F}r_0^2$ were slightly preferable to those from $v^2 = \mathrm{F}r_0$; but it appears from a number of the brighter southern stars at great distances from the centre that we are now obliged to give the preference to $v^2 = \mathrm{F}r_0$.

From certain investigations I made many years ago on the number and the distribution of the stars, it appears that they really do diminish in number with the distance from the Sun, which was assumed to be not far from the centre; and I believe it was this effect which once led to the idea of the gradual extinction of light in its passage through space.

It therefore appears advisable to use the equation for ρ_0 resulting from $v^2 = \mathrm{F}r_0$ in our further investigations, as given above on p. 474.

This change in the law of force necessitates the recomputation of the coefficients of the correction $\Delta\lambda$, $\Delta\mathrm{L}$, &c., to be applied to the adopted values λ, L, &c., as given on p. 371 of the last revision. But the calculation of the coefficients by such formulæ is difficult and liable to error. It will, perhaps, be better to proceed in the manner suggested by Lieutenant Stratford for the

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correction of the elements of the orbit of Halley's Comet. (Appendices to various *Nautical Almanacs*, p. 196.)

Thus to find $\frac{d\varpi}{dV}$ for any star, increase V by unity, and recompute; this will give the change in ϖ corresponding to a change of +1 in V, or approximately $\frac{d\varpi}{dV}$.

Similarly, $\frac{d\varpi}{d\Lambda}$ and $\frac{d\varpi}{d\Pi}$ may be found.

But instead of finding $\frac{d\varpi}{d\lambda}$, &c., we must increase the apex 1° in R.A., the N.P.D. being unchanged; and by computing the new λ and μ, and the new ϖ, we get $\frac{d\varpi}{da}$. Similarly by increasing the apex 1° in N.P.D., the R.A. remaining unchanged, and by computing the new λ, μ, and ν, and the new ϖ, we get $\frac{d\varpi}{d\beta}$.

And similarly we must treat the position of the Sun as seen from the Centre, and get $\frac{d\varpi}{d\mathit{A}\!\mathrm{R}}$ and $\frac{d\varpi}{d\Delta}$.

Of course, the same computations will apply to a system of corrections based upon radial velocity as well as upon parallax. And then from the two systems we get equations similar to

$$\mathfrak{A} \,.\, \Delta\lambda + \mathfrak{B} \,.\, \Delta\mu + \&\text{c.} \;+ \Delta\varpi = 0$$

$$\mathfrak{A} \,.\, \Delta\lambda + \mathfrak{B} \,.\, \Delta\mu + \&\text{c.} \;+ \Delta\frac{d\rho}{dt} = 0,$$

where $\Delta\lambda$, $\Delta\mu$, &c., are the corrections to be applied to the assumed values of λ, μ, &c., and where $\Delta\varpi$ is the observed minus the computed parallax, and where $\Delta\frac{d\rho}{dt}$ is the observed minus the computed radial velocity.

Jamaica:
1898 *June* 2.

Observations of Jupiter in 1898. By W. F. Denning.

During the period from 1898 March to July I observed *Jupiter* on 51 nights in my 10-inch Browning-With reflector. I usually employed one of Steinheil's "monocentric oculars," consisting of three cemented lenses and giving a power of 312. Occasionally I used the single lens of a Huygenian magnifying 252, and more rarely one of Browning's achromatic eye-pieces with a power of 488. But, ordinarily, the power of 312 possessed a marked advantage over the others.

I obtained about 280 estimated transits of the various markings on the planet, with a view to finding the individual